PMSTPCOL PEmails

From: Umana, Jessica
Sent: Tuesday, December 24, 2013 10:46 AM
To: Scott Head; Bill Mookhoek; Richard Bense
Cc: STPCOL
Subject: FYI: Draft/Advanced RAIs Attached
Attachments: RAI_7370.docx

Scott,

Attached for you is a draft copy of the RAIs to be issued on December 27, 2013. If you have any questions please let me know.

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U.S. Nuclear Regulatory Commission

Hearing Identifier: SouthTexas34Public_EX
Email Number: 3718

Mail Envelope Properties (6F9E3C9DCAB9E448AAA49B8772A448C5017CAD3C057C)

Subject: FYI: Draft/Advanced RAIs Attached
Sent Date: 12/24/2013 10:46:11 AM
Received Date: 12/24/2013 10:46:11 AM
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Files	**Size**	**Date & Time**
MESSAGE	312	12/24/2013 10:46:11 AM
RAI_7370.docx	29411	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Request for Additional Information 440
Issue Date: 12/23/2013
South Texas Project Units 3 and 4 - Dockets 52-012 and 52-013
Nuclear Innovation North America, LLC
Docket No. 52-012 and 52-013
Review Section: 09.01.02 - New and Spent Fuel Storage
Application Section: FSAR Section 9.1.2

QUESTIONS

09.01.02-43

Holtec Report No. HI-2135462, Section 2.3, "Applicable Codes and Standards," references Regulatory Guide (RG) 1.124, "Service Limits and Loading Combinations for Class 1 Linear-Type Component Support," Revision 1, which provides additional stress limits based on ultimate stress. These additional stress limits are not included in Holtec Report No. HI-2135462, Section 6.2.3, "Stress Limits for the "NF" Structure." Therefore, the staff requests that the applicant explain whether the stress limits in RG 1.124, Revision 1, were taken into account in the design of the fuel racks. If the stress limits in RG 1.124, Revision 1 were considered, then revise Holtec Report No. HI-2135462, Section 6.2.3, to include those requirements. If the stress limits were not considered, then provide the technical basis for not including them in the design calculations.

09.01.02-44

Holtec Report No. HI-2135462, Section 6.2.3, "Stress Limits for the 'NF' Structure," presents stress limits for the design of the fuel racks. The report does not include the stress limits for tension and bending for the Level D condition. These limits cannot be determined by "the minimum of 2 or 1.167 S_u/S_y times the corresponding Level A limits." Therefore, the staff requests that the applicant include the stress limits for tension and bending for the Level D condition in Holtec Report No. HI-2135462, Section 6.2.3, otherwise, provide the technical basis for not doing so.

09.01.02-45

Holtec Report No. HI-2135462, Section 6.7.1, “Fuel Rattling Loads," discusses the calculation of the maximum g-load that the rack imparts to the fuel assembly. The report states:

> The bounding fuel-to-cell wall impact load, at any level in the rack, for all runs is less than or equal 1,774 lb (see Table 6.6.1). For the five lumped mass model (with 25% at the ¼ points and 12.5% at the ends), the maximum g-load that the rack imparts on the fuel assembly can be computed as:
>
> $$a = \frac{4F}{w} = 10.51g$$
>
> where: a = maximum lateral acceleration in g’s
> F = maximum fuel-to-cell wall impact force (= 1,774 lbf)
> w = weight of one fuel assembly (conservatively taken to be 675 lbf)

The staff requests that the applicant identify where the maximum impact load (1,774 lbs) occurs, i.e., at the top of the fuel assembly or at an intermediate height. If the maximum impact load occurs at the top, where only 12.5% of the mass is assumed at the ends of the fuel assembly, the factor in the equation for the g-load should be 8 instead of 4. If the maximum impact load occurs at an intermediate height, where 25% of the mass is assumed, then 4 is correct; however, the top should also be checked, using 8 instead of 4 in the equation to determine which calculation results in the highest g-load. The staff requests that the applicant provide additional results based on the top location, or provide the technical basis explaining why the use of a factor of 4 is always correct.

09.01.02-46

NINA Letter, U7-C-NINA-NRC-130059, dated November 14, 2013, Attachment 5, Item 3 provides stuck fuel assembly evaluation required by the ABWR DCD, Subsection 9.1.2.3, but is not currently included in Holtec Report No. HI-2135462. In light of the information in Item 1, Figure 2.11, which shows that the cell-to-cell welds are 8 inches long, explain the assumption "that the net resultant pull force is resisted by only two 6-inch long cell-to-cell welds [...]," which is found in Item 3c) of Attachment 5.

09.01.02-47

NINA Letter, U7-C-NINA-NRC-130059, dated November 14, 2013, Attachment 5, Item 4 discusses the consideration of "out-of-phase movement of fuel assembly for determining maximum impact force on fuel assembly." The response referenced a full scale model test on a shaker table and indicated that the test results clearly show that the fuel assemblies rattle in unison. The staff requests that the applicant update Holtec Report No. HI-2135462 to document the basis for not considering out-of-phase movement of the fuel assembly in the determination of maximum impact force on the fuel assembly.

09.01.02-48

NINA Letter, U7-C-NINA-NRC-130059, dated November 14, 2013, Attachment 5, Item 5 discusses evaluation of cell-to-cell welds. The response stated that the stresses in the welds arising from fuel assembly impacts with the cell wall are calculated assuming the fuel assemblies in the adjacent cells move out of phase, and that the stresses arising from shear flow in the rack cross section are based on maximum computed R2 and R7 stress factors. However, the response did not provide any description of how the stresses in the welds are calculated for the two loadings above. Since the weld stress calculations are not based on a detailed model of the honeycomb rack design and use simplifying assumptions, details of the methodology used for determination of weld stresses due to fuel impact load and shear flow are needed for the staff to determine whether the evaluation is acceptable. The applicant is requested to:

(1) provide details of how the stresses in cell-to-cell welds are determined, including calculation of demand, the cell wall impact area assumed, and the weld length used; and

(2) explain how loads are transferred through tie bars by showing a free-body diagram of tie bar.

09.01.02-49

NINA Letter, U7-C-NINA-NRC-130059, dated November 14, 2013, Attachment 5, Item 6 discusses the design check for rack cell wall, base plate, and bearing plate. In order for the staff to complete its review, the applicant is requested to provide the following additional information:

(1) Regarding the analysis of fuel to cell wall impact, a plastic analysis of the cell wall is described. The staff notes that Holtec Report No. HI-2135462, Section 6.7.5, "Storage Cell Deformation," states that the primary stresses are within the elastic limit and plastic deformation of the cell wall from rattling action is ruled out. This appears to contradict the analysis methodology described in the response. Therefore, the staff requests that the applicant explain the inconsistency identified and provide the technical basis for the analysis method described in the Item 6 response. Also, the response states that the

allowable impact load is taken as 50% of the limit load (Q_L). Explain how the stress limits presented in Holtec Report No. HI-2135462 Section 6.2.3, "Stress Limits for the 'NF' Structure," are satisfied. If not satisfied, provide the technical basis. In addition, provide the assumed effective width of the cell wall and its basis. Also, explain why two load points were considered. Additionally, provide the distance between the load points and its basis, and explain whether fuel disposition (e.g., rotation and off from halfway between the cell walls) needs to be considered in the determination of the load points.

(2) Regarding the buckling analysis of the cell wall subject to rack-to-rack impact, the proposed changes to Holtec Report No. HI-2135462 state that the impact load is applied to the back surface of the rigid impactor as a uniform pressure across the full width of the rack. The staff requests that the applicant provide the technical basis for the assumption of the uniform pressure across the full width of the rack. Additionally, explain why the impact force time history was amplified to have a peak force of 557 kips, and how the displacement time history of the impactor was computed.

(3) Regarding the base plate design check, the response states that the compressive stress on the baseplate due to rack-to-rack impacts is discussed in Holtec Report No. HI-2135462, Section 6.7.6, "Rack-to-Rack and Rack-to-Wall Impacts." The staff requests that the applicant explain whether other stresses such as bending and shear stresses due to support reactions, as well as the combination effect, were also checked. If other stresses were checked, then provide the detailed design check. If other stresses were not checked, then provide the technical basis for not performing the check.

(4) Regarding the concrete bearing stress evaluation, Holtec Report No. HI-2135462, Section 6.9, "Qualification of the Bearing Pad and Bearing Pressure on the Pool Slab," indicates the entire bearing pad area was used to calculate the bearing stress. Since the bearing pad is described as a shim plate under compression, the staff requests that the applicant provide the technical basis for assuming that the bearing pad applies a uniform bearing stress in the concrete over the entire bearing pad area (18”x18”).

(5) Update the report HI-2135462, as necessary, to include the information requested above.

09.01.02-50

NINA Letter, U7-C-NINA-NRC-130059, dated November 14, 2013, Attachment 5, Item 7 describes the stiffness determination of impact springs. The response referred to a publication for methodology for determining spring constants for the DYNARACK model and provided the spring values used. The staff requests that the applicant include a discussion in the report about the methodology for determining the various spring constants, including the rack-to-rack and rack-to-wall impact springs. In addition, explain what is meant by “piecewise linear friction springs.”

09.01.02-51

NINA Letter, U7-C-NINA-NRC-130059, dated November 14, 2013, Attachment 5, Item 8 discusses fuel drop locations. The response indicated that one straight shallow drop and two deep drop scenarios are described in Holtec Report No. HI-2135462, including a deep drop above a support pedestal and a deep drop into the cell nearest the center of the rack with no credit taken for the center support leg. The staff requests that the applicant provide the technical basis for not considering a deep drop case into a cell along the perimeter and half way between the supports.

09.01.02-52

NINA Letter, U7-C-NINA-NRC-130059, dated November 14, 2013, Attachment 5, Item 9 discusses the energy balance method used to carry out the accidental fuel drop analysis using the Mathcad equation solver. In order for the staff to conclude that the method is acceptable, the applicant is requested to provide the following additional information:

(1) The proposed change to Holtec Report No. HI-2135462, Section 7.1.2.3, discusses the calculation of base plate deformation due to a deep drop (Scenario 1). To help the staff determine acceptability of the method, provide the derivations for the equation for baseplate deformation.

(2) The proposed change to report HI-2135462 Section 7.1.2.4 discusses the calculation of the impact force on the pedestal due to a deep drop (Scenario 2). To help the staff determine acceptability of the method, provide the derivations for the equation for the compressive stress in the pedestal.

(3) The associated mark-up of Holtec Report No. HI-2135462, Section 7, does not include Sections 7.2.1 and 7.2.2 from the original report dated July 31, 2013). Either confirm that these sections from the original report are retained, or identify where the information has been relocated.

09.01.02-53

NINA Letter, U7-C-NINA-NRC-130059, dated November 14, 2013, Attachment 5, Item 10 discusses the sliding interface between the bearing pad and the pool floor. The response states that sliding could occur either at the interface of the pedestal and the bearing pad or at the interface of the bearing pad and the pool floor liner. The response calculated the minimum available edge distance of 5.5" on the bearing pads, assuming that the pedestals are located centrally on the bearing pads. In order to complete its review, the staff needs the following clarifications:

1) Figure 2.7, Detail F, appears to show that that the typical corner pedestals are not located centrally on the bearing pad, and may not have the minimum edge distance of 5.5". The applicant is requested to explain how minimum required edge distance is achieved for the corner pedestals including description of the bearing pads being used for adjacent rack pedestals.

2) The response provided a mark-up of Section 6.9. It appears that the applicant updated the second paragraph of the section with the revised bearing pad size. However, the response does not include all changes needed for Section 6.9 to reflect the change to the bearing pad size. Therefore, the staff requests that the applicant revise Holtec Report No. HI-2135462, Section 6.9, to be consistent with the use of 18"x18" bearing pad size.

09.01.02-54

NINA Letter, U7-C-NINA-NRC-130059, dated November 14, 2013, Attachment 5, Item 11 addresses the staff's request to perform an additional sensitivity study for analysis run number 2 with partial loading, empty rack, and reduced integration time step. The staff's review of the response to Item 11 found that two additional computer runs were performed. Run number 22 is the same as run number 17 but with COF = 0.2, instead of 0.8. Run number 23 is same as run number 2 but with a reduced time step. The staff determined that the response did not completely address the original request. It appears from the displacements listed that partial loading may increase displacements significantly. Since run number 2 has the largest displacement at the base plate level, the staff requests the applicant to conduct an analysis for run number 2 with partial loading.

09.01.02-55

In NINA letter, U7-C-NINA-NRC-130059, dated November 14, 2013, Attachment 5, Item 16, the applicant provided additional information on gaps between racks, between fuel and cell wall, and between rack and pool wall. The response states:

> HI-2135462 addresses each of these issues as follows: [...] e) Following a seismic event, confirmation of the rack to rack gaps will be necessary to ensure the post-seismic rack configuration is acceptable. If the gaps are outside of tolerance limits, then the racks must be re-positioned or a reconciliation analysis must be performed.

The staff is unable to locate this information in the report; therefore, the staff requests that the applicant identify where this requirement is located in the report; otherwise, add the requirement to the report.

09.01.02-56

NINA Letter, U7-C-NINA-NRC-130059, dated November 14, 2013, Attachment 5, Item 18 discusses whether all fuel racks are permanently installed in the spent fuel pool. The response states:

> HI-2135462, which is incorporated by reference into the STP 3 & 4 FSAR, requires that all seven spent fuel racks are installed in the spent fuel pool. Any alternate layout will require approval in accordance with the regulatory change processes from 10 CFR Part 52 or Part 50, as appropriate.

The staff is unable to locate this information in the report; therefore, the staff requests that the applicant identify where the statements are located in the report; otherwise, add the statements in the report.

09.01.02-57

NINA Letter, U7-C-NINA-NRC-130059, dated November 14, 2013, Attachment 5, Item 21 discusses the number and locations of support feet for the spent fuel racks. The staff determined that there is no figure in Holtec Report No. HI-2135462 showing a plan view, with dimensions, of the locations of all support feet and bearing pads for the 7-rack configuration. Therefore, the staff requests that the applicant provide a figure in Holtec Report No. HI-2135462 of a plan view showing the locations of the support feet and bearing pads for all the racks in the spent fuel pool, with dimensions.

09.01.02-58

NINA Letter, U7-C-NINA-NRC-130059, dated November 14, 2013, Attachment 5, Item 25 discusses the thermal loads. The response provided information on the thermal conditions considered in the analysis and design of the fuel racks. The staff's review of Holtec Report No. HI-2135462 found that the report did not explain why the thermal load at the base of a pedestal, due to expansion of the rack, is not considered. The applicant is requested to address this issue by considering that friction at the base of a pedestal will likely induce lateral force at the base of the pedestal.

09.01.02-59

NINA Letter, U7-C-NINA-NRC-130059, dated November 14, 2013, Attachment 5, Item 36 discusses the modeling of fluid coupling. The response described the methodology for modeling fluid around the rack. The staff requests that the applicant update the report to include the information provided in the response.

09.01.02-60

NINA Letter, U7-C-NINA-NRC-130059, dated November 14, 2013, Attachment 5, Item 38 discusses stiffness and damping of fuel assemblies. The response states that the fuel assemblies are modeled as uncoupled lumped masses, and that there is no structural damping associated with the modeling of the fuel assemblies. The response refers to a publication for determining the spring stiffness for fuel to cell wall impact. However, it is not clear to the staff if modeling of the fuel assembly as uncoupled masses, which does not take into account the elastic properties of the fuel assembly and the lateral support at the base plate, will result in a conservative estimate of impact loads on the fuel assembly. The staff requests that the applicant provide the technical basis for this assumption. Additionally, the response indicates that impact spring stiffness for the fuel assembly lumped masses is calculated assuming impact is simulated by a uniform pressure on a circular section of cell wall with a radius larger than half of the inside dimension of the cell. Provide the technical basis for this approach.

09.01.02-61

NINA Letter, U7-C-NINA-NRC-130059, dated November 14, 2013, Attachment 5, Item 43 discusses the modeling of weld details. The response states that the forces acting on the cell to baseplate welds are determined with the aid of ANSYS; however, Section 6.7.9 of the Holtec Report No. HI-2135462 does not mention use of ANSYS for cell to base plate welds. The staff requests that the applicant explain the inconsistency.

09.01.02-62

NINA Letter, U7-C-NINA-NRC-130059, dated November 14, 2013, Attachment 5, Item 46 discusses the validation of computer codes. The staff review of Holtec Report No. HI-2135462 did not find sufficient information on this issue. The staff requests that the applicant include a list of all computer codes used, including a description of scope of use and validation information for their use.

09.01.02-63

In NINA letter, U7-C-NINA-NRC-130059, dated November 14, 2013, Attachment 5, the response to Item 48 provided the seismic analysis results of maximum rocking and uplift of the fuel racks. The applicant is requested to include in Holtec Report No. HI-2135462 the evaluation results of maximum rocking angle of the rack and the maximum uplift height of a support pedestal.

09.01.02-64

NINA Letter, U7-C-NINA-NRC-130059, dated November 14, 2013, Attachment 5, Item 50 discusses details of the methodology used to calculate buckling stress in the cell wall at the bottom of the rack. The response states:

> The modeled height of the cells is 4.875”, which equals the distance from the top of the rack base plate to the bottom of the neutron absorber sheathing. This is the most critical area for buckling since the cell wall acts alone in compression. Above 4.875" the buckling potential is diminished due to the presence of the neutron absorber sheathing, which is welded directly to the cell wall.

The staff’s review of the response found that additional justifications are needed for the approach used. The applicant is requested to provide the following additional information:

(1) The response states that the top edges of the finite element model are laterally restrained in the x and y directions. Provide the technical basis for the boundary constraint assumed in the design-basis buckling evaluation, including results of any sensitivity study due to variations in the boundary constraints.

(2) The staff notes that the integrity of the welds connecting the sheathing to the cell wall appears to be assumed. Provide the technical basis for this assumption including details of evaluation of the sheathing-to-cell wall attachment welds.

(3) It is not clear from the response to Item 50 whether the maximum predicted cell wall compressive stress at any location in any rack is used in the buckling evaluation. Provide a figure of the 7-rack arrangement showing the horizontal and vertical location of maximum compressive stress in the cell wall. Define the magnitude of compressive stress and confirm that this value is used in the buckling evaluation. If this is not the case, explain why a lower value is appropriate.

09.01.02-65

NINA Letter, U7-C-NINA-NRC-130059, dated November 14, 2013, Attachment 5, Item 51 discusses punching shear analysis for the rack base plate at the pedestal location. The response states that seismic load on the pedestal is greater than fuel drop load. A punching shear calculation is added to Holtec Report No. HI-2135462 in Section 6.7.11. The equation uses 4 times the length of one side (13.5") of the female pedestal block in the calculation of the shear area. Considering that only 2 sides of the female pedestal are available at the corners, the staff requests that the applicant provide the technical basis for using 4 times the length of one side of the pedestal block in the calculation for the shear area.

09.01.02-66

NINA Letter, U7-C-NINA-NRC-130059, dated November 14, 2013, Attachment 5, Item 65 discusses how equipment storage areas around the pool will be controlled, evaluated, and documented, to ensure that the design-basis seismic analysis of racks and pool walls reflects actual as-built gap conditions. The response states that "to ensure there are no impacts between the racks and equipment stored around the perimeter of the spent fuel pool, there is an exclusion zone of 7 inches around the perimeter of the racks where equipment storage is prohibited." The staff determined that specifying an exclusion zone can avoid impact between the racks and the equipment, provided it is conservatively defined with a suitable margin on the maximum predicted displacement at the top of the racks (6.78"). The staff notes that a 7" exclusion zone leaves very little margin, and requests that the applicant provide its technical basis for specifying 7". In addition, the specification of an exclusion zone does not address the effect that fluid gap reductions may have on the rack structural response, as a result of changes in the fluid coupling loads. Therefore, the applicant is requested to provide the technical basis for concluding that fluid gap reductions due to adding equipment has insignificant effect on the rack structural response.